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Photoconductivity and multiple exciton generation in arrays of coupled semiconductor nanoparticles MATTHEW BEARD, JOSEPH LUTHER, KELLY KNUTSEN, QING SONG, RANDY ELLINGSON, ARTHUR NOZIK, NREL — Three dimensional arrays of semiconductor nanocrystals (NCs) in p-i-n structures are a novel approach to solar energy conversion that offers the potential to control the microscopic charge generation, separation, and transport so as to maximize solar energy conversion efficiencies. A necessary characteristic of the NC arrays is that they exhibit very high conductivity for electrons and holes; this requires strong inter-NC electronic coupling and the subsequent formation of extended electronic states. Many factors, such as inter-NC spacing, site energy dispersion, NC size and shape, cross linking, and Coulomb charging determine the inter-NC coupling. In addition, efficient carrier transport in NC solids requires minimization of carrier loss processes such as surface trapping. All of these factors are highly interdependent. Time-resolved THz spectroscopy (TRTS) is a powerful experimental tool that measures both photoconductivity, in a non-contact fashion, and carrier dynamics simultaneously, with sub-picosecond temporal resolution. We report TRTS for a series of chemically treated PbSe NCs where the inter-NC separation has been varied in a systematic manner. We also report multiple exciton generation (MEG) QYs within the coupled arrays.

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